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Interactive comment on "Impacts of droughts on carbon sequestration by China's terrestrial ecosystems from 2000 to 2011" *by* Y. B. Liu et al.

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General:

This is an interesting paper that addresses an important issue of the carbon-water relationship under the climate change condition from 2000 to 2011. The study is supported by sound principles describing the carbon and water cycles. It is also a large undertaking that involves a large amount of model simulations and processing of spatially explicit vegetation, meteorological and soil data at a high spatial resolution for a large country and a decadal period. The choice of the drought index SPI is appropriate for its simplicity, temporal ïňĆexibility and spatial consistency. The analyses are meticu-

lously carried out. Overall, the paper is well written with clear expression. The table and ïňĄgures are of high quality. The conclusions are reasonable and relevant. The topic is suitable to the scope of this journal. The paper is publishable after taking the following issues into consideration.

Authors' response: Thank you for your encouragement. We will do our best to revise the manuscript.

1. The paper is heavily based on the simulation of the BEPS model. Therefore, some information on the performance of BEPS, e.g., validations, is needed. Such information can be based on this study or be cited from literatures.

Authors' response: Thank you for your constructive suggestion. The BEPS model has been successfully applied to simulate carbon and water fluxes at different spatial and temporal scales (Wang et al., 2005; Ju et al., 2006; Mo et al., 2008; Liu et al., 2013). We will add references related to the performance of BEPS.

2. Although the authors discussed water-carbon relationship here and there, and also near the end of the paper (pages 17483-17484), in-depth, explicit, and systematic discussion would be desirable. How does water affect carbon sequestration, especially on each component in the carbon cycle (Equations 1-3) explicitly? How do GPP, Rm, Rg, and Rh change with severity of drought? The authors claimed that one of novelties of this study is that the net exchange of carbon (NEP), instead of GPP or NPP, is examined. Therefore, more discussion on Rh and comparisons with earlier studies would be useful. In the end, it is an enhanced understanding of the processes involved and their underlying mechanisms that matters.

Authors' response: In BEPS model, total ecosystem respiration is simulated as the sum of autotrophic respiration (Ra) and heterotrophic respiration (Rh). Ra consists of growth respiration (Rg) and maintenance respiration (Rm). Rg is assumed 25% of GPP and Rm is related to temperature, sizes of different vegetation pools, inherent maintenance respiration rates at a reference temperature of these pools. The soil carbon dynamics is

simulated using the approach adopted from the CENTURY model (Parton et al., 1993). Rh is a function of the abiotic factors of soil temperature and soil moisture, the sizes of various soil carbon pools, and inherent maximum rate of these pools. The respiration rates of some soil carbon pools are also affected by soil texture and the lignin content of litter. Drought has a negative effect of GPP, and consequently on Rg. Long-term drought will cause the decrease of biomass and Rm will decrease correspondingly. Therefore, GPP, Rm, and Rg will decrease the severity of drought. The response of Rh to the severity of drought is inversely parabolic. It deceases with departure of soil water content from an optical value (typically 60% of porosity). Drought normally enhances Rh in areas with soil content usually above 60% of porosity and limits Rh in areas with soil content below 60% of porosity, which has been confirmed by flux measurements. We will add above information and compare our results with previous reports in the revised manuscript.

3. The impacts of droughts on carbon sequestration by vegetation type need to be analyzed, in combination with the associated meteorological and soil conditions, so that a broad range of readers can be beneïňĄted as they may not be familiar with the vegetation compositions in the regions classiïňĄed in this paper.

Authors' response: We will analyze the impacts of droughts on carbon sequestration for different major vegetation types in China, in combination with meteorological and soil conditions.

Specific:

P 17470, L 7: Change "categories" to "severities".

Authors' response: We will make this change.

P 17470, L 11: Delete "typical".

Authors' response: We will make this change.

P 17473, L 5: Change "for whole country" to "in the entire country".

Authors' response: We will make this change.

P 17474, L 12-13: Change "borrowed" to "adopted".

Authors' response: We will make this change.

P 17476, L 9-11: How is incoming radiation estimated? Please give more details or some references.

Authors' response: We describe in detail how incoming radiation estimated with the measurements of sunshine duration and add some references.

P 17477: The authors may mention that Equations (6) and (7) can be calculated for each grid.

Authors' response: We will make this change.

P 17479, L 11: Change "departure" to "anomaly". Do the same for Figure 5.

Authors' response: We will make this change.

P 17484, L 11: Is BEPS only driven by remote sensing data in this study?

Authors' response: BEPS was driven by spatially distributed remote sensing data (leaf area index, land cover), daily meteorological data, and soil texture data. We will clarify this confusion.

P 17485, L 8-9: The authors can mention that the indirect effects of fires, diseases, and insects are partially presented in the LAI data.

Authors' response: We will discuss this issue in the revised manuscript.

Fig. 3 and 4. Change "categories" to "severities" in the caption.

Authors' response: We will make this change.

Fig. 5. Change "departure" to "anomaly" in the caption and figure y-axis label.

Authors' response: We will make this change.

Fig. 6. Provide unit of NEP in the caption.

Authors' response: We will make this change.

Fig. 7. Provide unit of NEP, GPP, and RE in the caption and y-axis label. Explain shadows (grey bars).

Authors' response: We will make this change. Shadows (grey bars) in Fig. 7 indicate years in which drought occurred in China during the past decade.

Fig. 6, 7 and 8 may be enlarged.

Authors' response: We will make this change.

References:

Ju, W.M. et al., 2006. Modelling multi-year coupled carbon and water fluxes in a boreal aspen forest. Agricultural and Forest Meteorology, 140(1-4): 136-151. Liu, Y. et al., 2013. Changes of net primary productivity in China during recent 11 years detected using an ecological model driven by MODIS data. Frontiers of Earth Science, 7(1): 112-127.

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Parton, W.J. et al., 1993. Observations and Modeling of Biomass and Soil Organic-Matter Dynamics for the Grassland Biome Worldwide. Global Biogeochemical Cycles, 7(4): 785-809.

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